SITE: CHEMTRONICS
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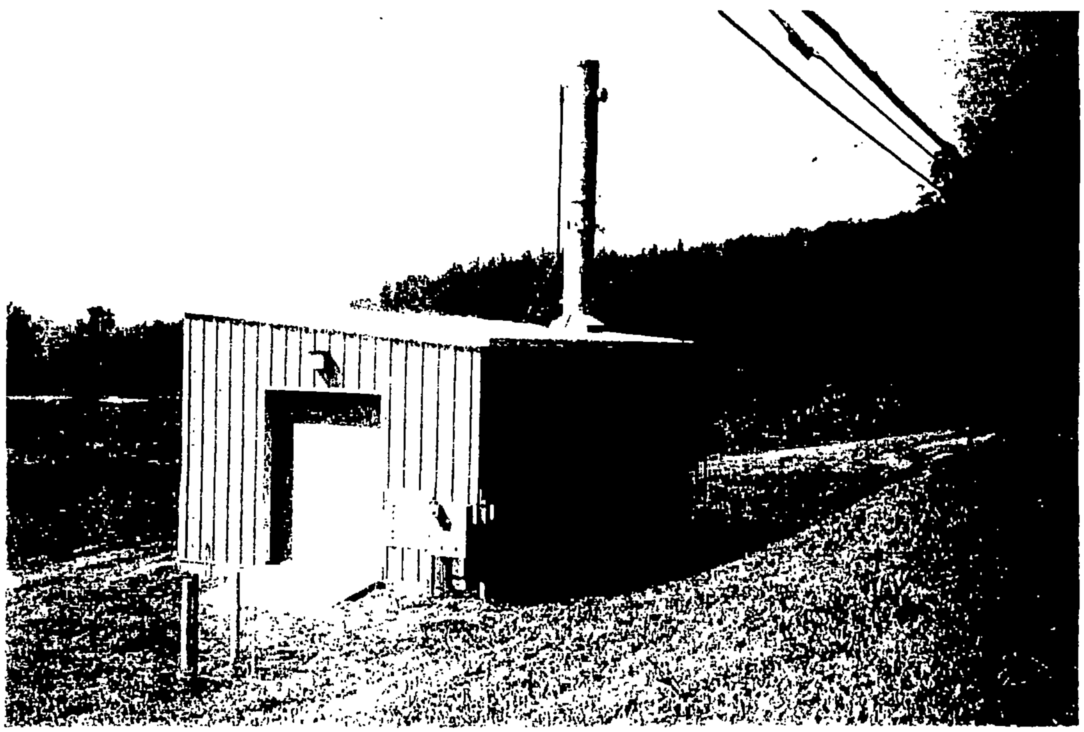
US Army Corps
of Engineers
Nashville District

FINAL
Superfund Five Year Review Report
Chemtronics Site, Swannanoa, NC
EPA ID: NCD095459392



Prepared for

USEPA Region 4
August 2002

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FINAL
2002 FIVE YEAR REVIEW
REPORT
CHEMTRONICS SUPERFUND SITE

FINAL

SUPERFUND FIVE YEAR REVIEW REPORT
CHEMTRONICS SUPERFUND SITE
SWANNANOA, BUNCOMBE COUNTY, NC
EPA ID: NCD095459392

Prepared for

The U.S. Environmental Protection Agency, Region 4
Atlanta, GA

Prepared by

The U.S. Army Corps of Engineers, Nashville District
Nashville, TN

August 2002

USEPA Five Year Review Signature Cover

Site name: Chemtronics			**EPA ID**: NCD095459392
Region: 04	**State** NC	**City/County**: Swannanoa, Buncombe County	
LTRA (highlight): Y **N**		**Construction completion date:** January 1993	
Fund/PRP Lead: PRP			**NPL status**: Currently on Final NPL
Lead agency: EPA, Region 4			
Who conducted the review (EPA Region, state, Federal agencies or contractor): US Army Corps of Engineers, Nashville District			
Dates review conducted: March 2001-March 2002			**Date(s) of site visit**: August 9, 2001
Whether first or successive review: Successive Review			
Circle: **Statutory** Policy		**Due date**: March 2002	
Trigger for this review (name and date): Five years from April 2002			
Recycling, reuse, redevelopment site (highlight): No			

Issues:

A list of issues were identified. See attached report Section 9.0, Issues.

Recommendations:

Recommendations are listed in the attached report, Section 10.0, Recommendations and Follow-up Actions.

Protectiveness Statement(s):

The portion of the site remedy dealing with potential soil exposures (i.e., the caps) appears to be protective of human health and the environment.

Since there are no current onsite groundwater receptors and there is currently no indication of contaminated groundwater or surface water exiting the property, the remedy is considered protective in the short-term. However, groundwater, in the long term at the Chemtronics site is not protective of human health and the environment due to the following reasons: the current monitoring well system is insufficient to determine if the plumes are being captured, groundwater is likely migrating to a degree and discharging to adjacent surface water, groundwater performance standards are not being met onsite and groundwater is not currently "restored", as ARARs are lower than the ROD standards, MSD violations have occurred, and there is no documentation of deed restrictions or future groundwater use restrictions for the site.

The next Five Year Review should be scheduled five years from the date of this Review, in April 2007.

Other Comments:

The issues noted during this review are not immediate threats to the protectiveness of the remedy. Once these items are investigated and corrected, long-term protectiveness, operation, and site safety will be improved.

Approval of USEPA Regional Administrator or Division Director, and Date

Signature 9/27/02 *Date*

Richard D. Green, Director Waste Management Division

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List of Acronyms
Chemtronics Site
Swannanoa, NC

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amsl	above mean sea level
ARARs	Applicable or Relevant and Appropriate Requirements
AWQC	Ambient Water Quality Criteria
BVAS	Back Valley Air Stripper
BVEQT	Back Valley/Equalization
BW	Bedrock Monitoring Well
BZ	3-quinuclidinylbenzilate
CS	o-chlorobenzylidene malononitrile
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CFR	Code of Federal Regulations
CWA	Clean Water Act
DA	disposal areas
DCA	Dichloroethane
DCE	Dicholorethene
DDD	1,1-dichloro-2,2-di(4-chlorophenyl)ethane
DQOs	Data Quality Objectives
DTW	Deep Extraction Well
EPA	Environmental Protection Agency
EW	Extraction Well
Fe	Iron
FS	Feasibility Study
FVAS	Front Valley Air Stripper
FVCA-3E	Front Valley Carbon Effluent
FVCAR-1	Front Valley/Carbon#1
FVCAR-3	Front Valley/Carbon#3
FVEQT	Front Valley/Equalization
gpm	gallons per minute
HI	Hazard Indices
HNu	Photo ionization analyzer
HSL	Hazardous Substance List
HSWA	Hazardous Solid Waste Amendments
HTRW	Hazardous Toxic Radiological Waste
IW	Intermediate Monitoring Well
lbs	pounds
MCL	Maximum Contaminant Level
mg/l	milligrams per liter
Mn	Manganese
MSD	Metropolitan Sewerage Discharge
MW	Monitoring Well
NAAQS	National Ambient Air Quality Standards
NCAC	North Carolina Administrative Code

List of Acronyms
Chemtronics Site
Swannanoa, NC

NCDENR	North Carolina Department of Environment and Natural Resources
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
NOV	Notice of Violation
NPDES	National Pollutant Discharge Elimination System
O & M	Operations and Maintenance
OSHA	Occupational Safety and Health Administration
PCBs	Polychlorinated biphenyls
PCE	Tetrachloroethene
pH	Logarithmic Measure of Hydrogen Ion
PMCLG	Proposed Maximum Contaminant Level Goal
POP	Project Operations Plan
ppb	parts per billion
PPLV	Preliminary Pollutant Limit Value
ppm	parts per million
PRP	Potential Responsible Party
PS	Performance Standard
RA	Remedial Action
RAO	Remedial Action Objectives
RCRA	Resource Conservation and Recovery Act
RD/RA	Remedial Design/Remedial Action
RDX	Hexahydro-1,3,5-trinitro-1,3,5-triazine
R_fD	Reference Dose
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RSD	Risk Specific Dose
RW	Sediment/Surface Water Sample Identifier
SDWA	Safe Drinking Water Act
STW	Surface Extraction Well
SW	Surface Monitoring Well
TCE	Trichloroethene
TNT	Trinitrotoluene
TSD	Treatment, Storage and Disposal
TSS	Total Suspended Solids
μg/L	micrograms per liter
USACE	United States Army Corps of Engineers
USAIWQC	US Army Water Quality Criteria
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compounds
WNCRAQA	Western North Carolina Regional Air Quality Agency

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FINAL
SUPERFUND FIVE YEAR REVIEW REPORT

CHEMTRONICS SITE
SWANNANOA, NORTH CAROLINA

1.0 Introduction

The United States Army Corps of Engineers, Nashville District (USACE), on behalf of the United States Environmental Protection Agency (USEPA), Region 4, has conducted a Five Year Review of the remedial actions implemented at the Chemtronics Superfund Site (EPA ID # NCD095459392), located in Buncombe County, North Carolina, near the town of Swannanoa. The review was conducted from March 2001 through March 2002. This report documents the results of the review. In accordance with the USEPA's *2001 Comprehensive Five-Year Review Guidance* **[1]**:

> USEPA must implement Five Year Reviews consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or "Superfund") and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) Part 300.430(f)(4)(iii) of the Code of Federal Regulations (CFR), which states:
>
> > *"If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action."*

The methods, findings, conclusions and significant issues found during the review are documented in the Five Year Review report.

The Chemtronics site remedy involved leaving hazardous substances in place and capping the waste areas and groundwater extraction and treatment. Therefore, a Five Year Review is required from the date of commencement of construction of the remedial action to ensure that the remedy continues to provide adequate protection. Remedial construction began in December 1991 and was completed in January 1993. This is the first Five Year Review for the Chemtronics Superfund Site. Two drafts were prepared, one in February 1997 **[2]**, and the other in June of 1999 **[3]**. Neither of the two documents was finalized.

1.1 Purpose

The purpose of this Five Year Review is to evaluate the remedy at the Chemtronics site in Swannanoa, North Carolina and to determine if the action remains protective of public health and the environment.

More specifically, the purpose is:

- to confirm that the remedy as specified in the April 1988 Enforcement Record of Decision (ROD) **[4]**, April 1989 ROD Amendment **[5]**, and/or the Final Design Analysis dated February 1991**[6]**, remains effective at protecting human health and the environment (i.e., the remedy is operating and functioning as designed, institutional controls are in place and are protective), and

- to evaluate whether the cleanup levels specified in the ROD remain protective of human health and the environment.

1.2 Integration With Resource Conservation and Recovery (RCRA) Activities

Currently, there are on-going RCRA and CERCLA assessment and remediation projects at the Chemtronics site. The site operated as a Treatment, Storage, and Disposal (TSD) facility from 1980-1995, and entered into Hazardous Solid Waste Amendments (HSWA) corrective action in 1997 with the state of North Carolina. There are multiple groundwater plumes associated with the RCRA units, and some of the plumes are co-mingled with the groundwater monitored as part of the CERCLA action **[7]**.

Regulatory overlap between the two programs and agencies is inevitable. The Potential Responsible Parties (PRPs) are concerned that unnecessary or inefficient actions will occur unless a concerted effort is made to address the environmental impacts at the site in a comprehensive, holistic manner.

In January 2002, the PRPs decided to voluntarily develop an overall plan to manage the various environmental conditions at the site **[7; 8]**. The plan, referred to as the "Holistic Site Management Plan" (HSMP), is intended to provide clear and concise direction regarding subsequent site investigation and remediation, and provide a framework to support decision-making. Concepts such as the site conceptual model, regulatory strategy, and remedial action objectives/alternatives will be addressed in the plan. The plan will address both RCRA and CERCLA requirements at the site. Specifically, the goals for the plan are:

- Provide a concise and clear understanding of the regulatory and technical issues for managing the site

- Promote the development of a single, unified approach to managing the site in a manner that protects human health and the environment

- Define fundamental guiding principles to guide cost-effective, risk-based decision-making

- Establish a "road map" that defines what needs to be accomplished at the site and when, recognizing both regulatory priorities and PRP constraints

- Clearly communicate the steps needed to meet the defined goals

At the time of this Five Year Review, the HSMP was not complete. However, the PRPs agreed to prepare the HSMP as a means of addressing the recommendations made in the draft Five Year Review report, as discussed with the USEPA at a July 2, 2002 meeting. Responses to comments made on the draft report are given in **Appendix A.**

2.0 Site Chronology

Site chronology is summarized in **Table 2-1.** The Chemtronics Site was first included on the NPL List in December 1982 with USEPA assuming the lead responsibility for the site. In November 1983, six (PRPs) were identified, however, only three of the six were found to be viable: Chemtronics, Inc., Hoechst Celanese Corporation, and Northrop Corporation (which are currently known as Halliburton, Celanese, and Northrop Grumman Corporation, respectfully). Chemtronics and Northrop signed an Administrative Order in October 1985 **[9]** to perform a Remedial Investigation/Feasibility Study (RI/FS). Heochst Celanese Corporation declined to participate in the RI/FS process.

The USEPA approved the Remedial Investigation (RI) Report in April 1987. The FS was approved in March of 1988. The original ROD was signed on April 5, 1988 and an amendment to the ROD was issued on April 26, 1989 **[5].** The ROD amendment specified the deletion of the requirement to solidify the soils in Disposal Area (DA) - 23 as a result of a transcription error made in the Remedial Investigation data which was carried over into the initial ROD.

Negotiations with the three PRPs on the remedial design/remedial action (RD/RA) Consent Decree was initiated in June 1988. The USEPA issued an Unilateral Administrative Order to all three PRPs dated March 22, 1989 **[10].** All three PRPs participated in the RD/RA. Rust served as the PRP's consultant, preparing the remedial design and many of the early monitoring reports. Canonie Environmental Services Corporation out of King of Prussia, PA served as prime environmental contractor for the PRP's. Nimmo, the initial site Operations and Maintenance (O &M) contractor, was replaced by Fletcher (now known as Altamont Environmental) in May 2000. Final design specifications were completed in July 1991 **[6].** Remedial construction began in December 1991 and was completed in January 1993 **[3].**

3.0 Background

3.1 Site Description and Physical Setting

The Chemtronics site occupies approximately 1,027 acres of rural land in Buncombe County, North Carolina, near the town of Swannanoa (see site location map **Figure 3-1**). The site lies within the Blue Ridge Province of the southern Appalachians with the center of the site lying at latitude 35° 38' 18" north and longitude 82° 26' 8" west. The site is bounded by on the east by Bee Tree Road and Bee Tree Creek.

The site can be divided into two geographical subsections known as the Front Valley and the Back Valley (which is also known as Gregg Valley). The topography of the site is steep, ranging from 2,200 to 3,400 feet above mean sea level (amsl). The Front Valley contains the Unnamed Stream and Gregg Branch drains the Back Valley. The site lies on the southeast side of Bartlett Mountain and is moderately to heavily vegetated. All surface water from the site drains into small tributaries of Bee Tree Creek or directly into Bee Tree Creek. This creek flows into the Swannanoa River, which ultimately empties into the French Broad River (see site boundary **Figure 3-2**)**[3].**

3.2 Hydrogeology

Three hydrogeologic units underlie the Chemtronics site: the shallow saprolite, the transitional saprolite/weathered bedrock, and the bedrock. These units are hydraulically interconnected in both valleys. The first two zones were combined and viewed as one "surficial " zone, and it was demonstrated in the RI that these zones are interconnected **[4]**. The groundwater underlying the site was classified as Class IIB using USEPA Groundwater Classifications Guidelines (December 1986), since there is potential future use for this aquifer as a source of drinking water **[4].**

Under natural static conditions, groundwater flow in the Front Valley is to the south, toward the Unnamed Stream. The hydrogeology of the Back Valley is similar to that of the Front Valley, however, the surface of the bedrock is shallower and the transitional unit is largely weathered soil although some hard layers are present. Groundwater flow in the Back Valley is primarily to the south and southeast **[3].**

3.3 Land Use

The Chemtronics site has been used for industrial purposes since 1952. It is anticipated that land use in future the will not change. The site lies within the Blue Ridge Province of the southern Appalachians and is characterized by steep terrain and is heavily wooded. It is bordered to the north and west by sparsely populated woodlands, primarily national forests. Immediately to the south of the site, there are several industrial facilities, which was once part of the original Oerlikon property. Eight miles to the east of the site lies the city of Asheville, North Carolina.

3.4 History of Contamination

The property was first developed and operated as an industrial facility in 1952. The site has been owned/operated by Oerlikon Tool and Arms Corporation of America (1952-1959), Celanese Corporation of America (Hoechst Celanese Corporation)(1959-1965), Northrop Carolina, Inc. (Northrop Corporation) (1965-1971), and Chemtronics, Inc. (1978-present). The site operated under the name of Amcel Propulsion, Inc (1959-1965) under both Oerlikon and Celanese. The site is currently owned by Chemtronics, Inc., a subsidiary of the Halliburton Company. The primary products manufactured on site were explosives, incapacitating agents, and chemical intermediates.

Waste disposal occurred over a small portion (less than ten acres) of the site. Twenty-three individual on-site disposal areas were identified and described by reviewing records and through interviews with former site employees. Disposal practices prior to 1971 are not well defined. From 1952 to 1971, solid waste materials and possibly solvents were reportedly incinerated in pits dug in the burning ground, also known as the (Acid Pit Area). Chemical wastes from the production of the incapacitating, surety agent, 3-quinuclidinyl benzilate (BZ), and the tear gas agent, o-chlorobenzylidene malononitrile (CS), were placed in 55 gallon drums and reportedly covered with a decontaminating "kill" solution. These drums were buried in disposal areas (DA), DA-6, DA-7/8, DA-9, and DA-10/11. Chemical wastes were also disposed of in trenches located in the Acid Pit **[3]**. Refer to **Figure 3-3** and **Figure 3-4** for the location of the Disposal Areas.

From 1971-1975, most of the liquid wastes generated on-site went to the Buncombe County Sewer System following some form of neutralization and equalization. Small volumes were dumped in on-site pits/trenches. Solid wastes, rocket motors, explosive wastes, etc., were burned in an area, that later became known as the Acid Pit Area. From 1975-1979, Chemtronics, Inc. constructed pits/trenches, as needed, for the disposal of spent acid and various organic wastes in the Acid Pit Area **[3]**.

In 1980, the State of North Carolina ordered Chemtronics to discontinue all discharges to these disposal pits/trenches. The pits were subsequently backfilled. Consequently, in 1979, Chemtronics installed a 500,000 gallon lined lagoon for biotreatment of wastewaters on top of an abandoned leach field for the main production/processing building (Building 113). After the lagoon was filled, the lagoon lost its contents due to incompatibility of the liner with the brominated waste initially introduced into the lagoon. Reconstruction of the biolagoon, with a different liner, was completed in August 1980 and was in use until 1984 at which time the biolagoon was deactivated. This entire area, including the abandoned leach field and the biolagoon has been designated as DA-23. The biolagoon has since been closed, and is subject to RCRA regulations (see **Figure 3-3**) **[3]**.

4.0 Media and Contaminants Identified in the Remedial Investigation (RI)

The RI for the Chemtronics site focused on twenty-three individual disposal areas that have been identified and grouped into six discrete source areas requiring remediation. These source areas are designated as: disposal areas (DA) DA-23 and DA-10/11 located in the Front Valley, and DA-6, DA-7/8, DA-9 and the Acid Pit Area located in the Back Valley. See **Figure 3-3** and **3-4** for the DA locations.

The media affected by disposal practices at this site were: soil, sediment, groundwater, and surface water. During the RI, samples were collected from each medium from the disposal areas and analyzed for compounds on the Hazardous Substance List (HSL) as well as other selected compounds. Indicator parameters were selected for subsequent samples after reviewing the data.

4.1 Air Contamination

During the RI a HNu photoionization analyzer and cyanide sensitive colorimetric indicator tubes were used to monitor the air. The 5 ppm action level established in the Chemtronics Project Operations Plan (POP) and Health & Safety Plan was exceeded on several occasions. No cyanide was detected by the colorimetric tube **[4].** No other air data were collected.

4.2 Soil Contamination

To determine the depth of disposed wastes and the vertical and horizontal extent of contamination, test pits were excavated and samples were collected and analyzed for site contaminants. The three disposal areas where test pits were not excavated during the RI were DA-9, DA-23 and the Acid Pit Area.

4.2.1 Front Valley

There are two disposal areas in the Front Valley where surface and subsurface soil samples were collected and analyzed: DA-l0/ll and DA-23. At DA-10/11 the analytes detected include volatile organic compounds, extractable organic compounds, 1,1-dichloro-2,2-di(4-chlorophenyl)ethane (4,4-DDD), hexahydro-1,3,5-trinitro-1,3,5, triazine, (RDX), o-chlorobenzylidene malononitrile (CS), total organic halide, and cyanide.

The analytes detected at DA-23 included volatile organic compounds, explosives, CS, BZ, and their degradative products, total organic halides, and total cyanide**[4].**

4.2.2 Back Valley

The Back Valley contains the following disposal areas: DA-6, DA-7/8, DA-9, and the Acid Pit Area. Soil samples were collected and analyzed from each of these areas.

The analytes detected at these disposal areas include a variety of compounds including volatile organic compounds extractable organic compounds, pesticides, polychlorinated biphenyls (PCBs), explosives, total organic halide, cyanide, metals and the BZ degradation product, benzylic acid/benzophenone **[4].**

4.3 Groundwater Contamination

All monitoring wells were sampled in June 1986 as part of the RI. Twelve of these wells were re-sampled in October 1987 in an attempt to verify concentrations.

4.3.1 Front Valley

The following discussion is based on the analytical results of the RI. The extent of the groundwater contamination in the surficial zone in the Front Valley is greatest downgradient of DA-23. The majority of contaminants (volatiles and BZ degradation products) from this area appear to be migrating with the groundwater and discharging locally into a northern tributary of the unnamed branch. Groundwater contamination in other areas within the valley are most likely due to the presence of other old leach fields (such as that of Building 107) or other past activities. Finally, no contaminants were detected in groundwater samples collected from wells downgradient of DA-10/11, which indicates that contaminants have not moved from this area **[4].**

The RI stated that the only area of the bedrock aquifer affected by disposal practices in the front valley are in the vicinity of BW-4 and BW-5. Three compounds have been detected in the bedrock aquifer of the Front Valley: 1,2-dichloroethane, bis(2-ethylhexyl)phthalate, and chloroform. At the time of the ROD, no contamination had been detected in BW-6 and IW-1 **[4].**

4.3.2 Back Valley

Groundwater in the surficial zone of the Back Valley is primarily contaminated by two volatile organic priority pollutants: 1,2-dichloroethane and trichloroethene that likely originated from the acid pits disposal area, DA-7/8 and DA-9. Concentrations of these compounds are highest near the disposal areas. The presence of these two compounds in the groundwater most likely extends further down the center of the valley but not as far as wells BW-ll and IW-3, approximately 600 to 900 feet downgradient as neither contaminant was detected in either of these wells.

The other contaminants detected in the surficial zone of the Back Valley occur less frequently and generally in lower concentrations. These contaminants include other volatile organic compounds, extractable organic compounds, explosives, metals, cyanide, and BZ degradation products. The distribution of these contaminants in the groundwater does not appear to be widespread or to extend further than 300 feet from the disposal areas according to analytical data from the downgradient monitor wells.

This indicates that contaminants within the surficial zone are migrating downward as well as laterally and will enter the bedrock zone. The downgradient lateral extent of this contamination has not yet reached the confluence of the eastern and western tributaries of Gregg Branch. The limit of contaminant migration to date appears to be within the area between wells MW X-3 and BW-II.

Contamination by chemicals other than 1,2-dichloroethane and trichloroethene is generally limited to portions of the aquifer that are close to DA-7/8, DA-9 and the acid pit area. Finally, for the RI, no contamination of the groundwater was detected downgradient of DA-6.

The bedrock zone in the Back Valley is contaminated by volatile organic compounds. The extent of this contamination is more pronounced southeast of the acid pit area, in the vicinity of MW BW-9, but these contaminants have not reached wells BW-11 or BW-12. Therefore, the downgradient lateral extent of this contamination should be within 600 feet of the disposal areas.

A trace quantity of benzylic acid/benzophenone, a BZ hydrolysis product, was detected in MW BW-II in the sample collected during the RI but was absent in the sample taken in October 1987 **[4].**

4.4 Surface Water and Sediment Contamination

The Chemtronics Site can be subdivided into two small valleys formed on an unnamed stream and the Gregg Branch. These two valleys are referred to as the Front Valley and the Back Valley. The sizes of the watersheds encompassed in each valley is 221 acres and 691 acres, respectively, and both drain into Bee Tree Creek. Between the two valleys is a ridge of 44 acres draining directly into Bee Tree Creek. An additional area on the property east of Gregg Branch also drains directly into Bee Tree Creek. These last two areas contain no known disposal areas. It is evident from surface topography that surface runoff from on-site disposal areas discharge directly to the unnamed or Gregg Branch only and not directly to Bee Tree Creek **[4].**

Surface water and sediment samples were collected from the Unnamed Tributary draining the Front Valley, Gregg Branch draining the Back Valley, Bee Tree Creek, and their tributaries. To ensure stream flow was indicative of base flow, sampling was conducted when storm runoff was negligible.

Analysis of surface water and sediment samples indicated contaminated base flow was entering the streams on-site. In all cases, concentrations decrease to levels below detection limits downstream of the suspected sources. Volatilization or dilution could be contributing to the reduced levels of contamination downstream. Concentrations of the contaminants associated with the sediment have decreased downstream indicating erosional transport mechanisms at work transporting contaminants away from the disposal areas. In general, metals were detected in sediments from the two on-site branches but not in sediments from Bee Tree Creek. This may be due to depositional differences at the sites.

4.4.1 Front Valley

Surface water data indicated the presence of volatile organic compounds and explosives. DA-23 was potentially the source of this contamination.

No explosives were detected in any of the sediment samples **[4].**

4.4.2 Back Valley

Surface water data collected during the RI may have been contaminated from a volatile organic source at DA7/8 or DA-9. No migration of volatiles organics is indicated from the surface water results from the acid pit or DA-6.

Sediment samples did not indicate that significant volatile organic contamination from surface runoff was occurring from any of the disposal areas in Back Valley **[4].**

Cyanide was detected in both surface water and sediment samples in the Back Valley. Cyanide that was found in a sediment sample from RW-21 is most likely due to runoff or erosion from DA-6 or the Acid Pit area **[4].**

5.0 Remedial Action Objectives

The following remedial action objectives (RAOs) were established in the 1988 Record of Decision (ROD) **[4].** The objectives were based on the regulatory requirements at the time, and the results of the Baseline Risk Assessment prepared during the RI. The RAOs are:

- To protect the public health and the environment from exposure to contaminated on-site soils through inhalation, direct contact, and erosion of soils in surface waters and wetlands;

- To prevent offsite migration of groundwater contamination; and

- To restore contaminated groundwater to levels protective of human health and the environment.

Although no RAOs directly addressed the potential interaction of groundwater and surface water and sediments in Gregg Branch, Bee Tree Creek, and the Unnamed Tributary, it is understood that one of the goals of preventing groundwater migration was to prevent contaminated discharge to surface waters. As stated in the ROD, the contaminant levels in surface water bodies were expected to decline with the implementation of groundwater and soil remediation. Thus, it was concluded that the direct remediation of surface water was not necessary **[4].** In addition, as discussed below in Section 6.1, surface water was initially monitored to document that the remediation activities did not have an adverse affect on biota present in the surface water bodies near the site.

5.1 Risk Assessment Summary

A Baseline Risk Assessment (BRA) was prepared during the RI, which evaluated potential exposure pathways to current/baseline (at that time) and potential future receptors. The results of the BRA were used to establish site cleanup levels (performance standards). The BRA was not available for this Five Year Review, so a detailed evaluation was not possible, but references to it and the results were obtained from other documents. An "Endangerment Assessment" was noted to be part of the FS **[5],** but that appendix was not available for this Five Year Review.

It was implied from various documents that two of human receptor populations considered in the BRA were site workers and future residents. It is assumed that the risk assessment was performed consistent with the guidance and methods available at that time. No information was reviewed that indicated that a quantitative ecological risk assessment was performed; however, this was not unusual at the time the RI/FS was prepared.

The routes of exposure evaluated in the BRA included **[4]**:

1) Ingestion of contaminated groundwater, surface water, and wildlife

2) Direct contact with the contaminants in the soil, surface waters, and groundwater

3) Inhalation of vapors and contaminated particles.

Although the site aquifer was not used for drinking water at the time of the BRA, potential future use was incorporated in the BRA. Fugitive dust generation was also considered in the BRA under the current scenario because the majority of the disposal areas were already vegetated. One area (DA-9) had numerous empty drums exposed, and was identified in the RI to have the greatest degree of risk to exposure to potential human receptors. The likelihood of exposure was noted in the BRA to be greatly reduced due to the remoteness of this disposal area **[4].**

The BRA determined that risks to human as a result of exposure to on-site contaminants via inhalation, ingestion and dermal contact were very low under the current (pre-remediation) scenario. For potential future use scenarios, the risk was slightly higher. Therefore, remediation and institutional controls for soil were noted as necessary to assure that an increased risk to human health is not posed in the future **[4].**

The presence of several contaminants found on site presented some special problems with respect to the establishment of performance standards (i.e., target cleanup levels). Since these chemicals had limited human health standards and supporting physiochemical and toxicological data, groundwater cleanup levels were developed in the FS in the form of " preliminary pollutant limit values (PPLVs)" for critical exposure pathways, using estimates of acceptable daily doses and chemical-specific partition coefficients. The calculations and supporting references for these PPLVs were presented in the Feasibility Study, and are given in **Appendix B** of this report **[11]**.

5.2 ARARs and Performance Standards

5.2.1 Applicable Or Relevant And Appropriate Requirements (ARARs)

This section describes criteria in place at the time of the ROD. Section 8.4 presents updates to the standards and criteria. The ROD considered the following applicable or relevant and appropriate requirements (ARARs) for the remedial actions and to establish Performance Standards (cleanup levels) for the site **[4]:**

- **Resource Conservation and Recovery Act (RCRA)** – RCRA specifications/ requirements (40 CFR –264 subparts K-N) for construction of the caps were considered in the remedial design. The ROD Amendment notes that capping of DA-23 will satisfy the post-closure requirements associated with the former biolagoon **[5]**. Also, as noted in Section 1.2, there are separate RCRA corrective actions monitoring activities ongoing **[7]**.

- **Clean Water Act (CWA)**– (40 CFR part 403) **[12]**. The CWA governs the federal ambient water quality criteria (AWQC) for the protection of human health and aquatic life (or the state of North Carolina's equivalents). AWQC are typically criteria to be considered but are not enforceable as standards for surface water bodies. However, as discussed above, it was determined in the ROD that direct remediation of surface water was not necessary. It is assumed that in lieu of monitoring surface water concentrations in the water bodies adjacent to the site and comparing data to the AWQC, toxicity testing of the surface water was performed, as described in Section 6.1.

- **Occupational Safety and Health Administration (OSHA)**– All field and construction activities complied with the regulations of OSHA.

- **Safe Drinking Water Act (SDWA) [13]** –Maximum Contaminant Levels (MCLs) for contaminants in groundwater were generally listed as the performance standards in the ROD. If either a MCL or proposed MCL Goal (PMCLG) was available, then the MCL or PMCLG was incorporated into the ROD. If neither of these were available, the values for the reference dose (R_fD), risk specific dose (RSD), Preliminary Pollutant Limit Value (PPLV), US Army Water Quality Criteria (USAIWQC), or the CWA AWQC were compared to one another. The most stringent of these values was incorporated into the ROD as the groundwater performance standard for that particular contaminant. At the time the ROD was issued, the State of North Carolina had adopted the standards set forth in the federal SDWA. No North Carolina groundwater standards were incorporated into the 1988 ROD as at the time the ROD was issued, as the State was employing federal MCLs as the State's groundwater cleanup criteria **[3]**.

- **National Pollutant Discharge Elimination System (NPDES)** – The NPDES requirements are being regulated by the local Metropolitan Sewerage Discharge (MSD), as discussed in Section 6.4. This was not relevant because the discharge of treated groundwater was not part of the selected remedy (although it was a discharge alternative incorporated into the ROD).

- **Endangered Species Act** – The recommended remedial alternative was determined to be protective of species listed as endangered or threatened. No information regarding endangered or threatened species potentially relevant to the remedy was available for this Five Year Review.

- **National Ambient Air Quality Standards** (NAAQS) – The ROD stated that any emissions from either the gas vents and/or the groundwater air strippers must meet all state and federal air standards.

5.2.2 Performance Standards

The Performance Standards (PS), site cleanup levels, and list of contaminants of concern for groundwater and soil remediation listed in the ROD are summarized in **Tables 5-1** and **5-2,** respectively. All of the groundwater cleanup levels were based on ARARs, not the risk assessment, with the exception of the explosive compounds.

The only site contaminant that had an established performance standard for soil at the time of the ROD was polychlorinated biphenyls (PCBs). The rest of the soil cleanup levels were developed in the BRA, as part of the PPLVs.

5.3 Trigger Mechanism

The ROD also had the following "trigger" provision regarding groundwater quality **[4]:**

> " Action levels for contaminants in the groundwater will be set with the State of North Carolina's concurrence. If these levels are reached during any sampling episode after the remedial activities achieve goal, this will trigger an immediate permanent remediation of the disposal area responsible for this level of contamination is reached downgradient of that disposal area. The action levels expected to be implemented are MCLs and PPLVs ".

As noted in the O & M Manual **[14]**, the purpose of the "trigger mechanism" is to enact a permanent remedy should capping not prove effective. The interpretation of "after remedial activities achieve goal" is critical, as it implies potentially significant actions would be necessary if there are future exceedances of the groundwater performance standards.

The O & M Manual **[14]** presented the data requirements for evaluating remedial performance and the statistical approach that should be applied to evaluate compliance with baseline conditions and the groundwater performance standards. A statistical analysis was performed and presented in the 1998 *Fifth Year Monitoring Report* **[15]** with the data that were available at the time (through 1997 for both valleys). The analysis showed some decline in concentrations for the majority of the contaminants. However, in numerous cases, the standard deviation was of equal or greater magnitude than the average. It was thought that the large standard deviations were due to the relatively low number of data points (sampling events) for the prescribed statistical method employed. The upper confidence limit, which is compared to the performance standard for groundwater compliance, is a direct function of the standard deviation. It was concluded that until steady state groundwater flow conditions are achieved and a larger number of data points have accumulated the prescribed statistical procedure cannot accurately represent the groundwater quality **[3]**. There was no discussion in the 1998 *Fifth Year Monitoring Report* as to whether these findings affected the "trigger mechanism". Another statistical evaluation is not due to be performed until the next Fifth Year Monitoring Report, due in 2003.

6.0 Remedy Selection and Implementation

The Remedial Action consisted of capping wastes in place in six separate areas, installing and operating of two groundwater extraction and treatment systems downgradient of the disposal areas in the Front Valley and Back Valley, and long-term monitoring of groundwater. The treatment for the extracted groundwater includes air stripping, filtration through activated carbon filter and discharge to the local MSD **[16]**. The components of the remedy are further described below.

6.1 Source Control

The prevention of exposure to contaminated on-site soils has been achieved by the installation of a multi-layer cap meeting the standards specified under 40 Code of Federal Regulations (CFR) Subsection 264, Subparts K-N. Caps were installed in the following areas: DA-6, DA-7/8, DA-9, DA-10/11, DA-23 and the Acid Pit. Security fencing, vegetative covers and a gas collection ventilation system (only at the Acid Pit Area), are also components of the implemented capping remedy.

Survey markers were incorporated into the caps so that settling of the caps could be monitored (see **Appendix H**, photo # 18 and # 21). Photo #7 shows the gas venting system installed at the Acid Pit Area. The capped disposal areas were fenced with a chain-linked fence and identified with signs attached to the fences (see photo # 2).

The water and sediment in the pond on the Unnamed Tributary in the Front Valley were sampled. No contamination was detected in the pond. As a precautionary measure, the PRPs removed the structure impounding the water and drained the pond.
As noted above in Section 3.1, groundwater flow in the Front Valley is to the south toward the Unnamed Stream. The groundwater plume from DA-23 is also migrating toward the stream in all three hydrologic units **[15]**.

A monitoring program was established for the surface water employing bioassays on the Unnamed Stream, Gregg Branch, and Bee Tree Creek. The purpose of this monitoring program was to insure no adverse impact on these streams during implementation of the remedial action and to establish a database to use to measure the success of the remedial action once implemented. The initial (baseline) bioassay sampling was conducted in February 1991 at five locations. The second bioassay samples were collected in April 1993, following completion of the remediation construction activities **[2]**. Two organisms were used in each event, *Pimephales promelas* and *Ceriodaphnia dubia.* No effects on the *Ceriodaphnia* were seen in either event, and no effect was observed on the *Pimephales* in the baseline sampling event. The *Pimephales* test in the second sampling showed chronic toxicity effects on growth at one of the five sampling locations. The results of the chronic toxicity on survival were inconclusive **[2]**.

The PRPs indicated that they intend to do more surface water evaluations and sediment sampling as a part of the RCRA activities, and the HSMP (see Section 1.2).

6.2 Migration Control

Groundwater migration control cannot be verified due to the insufficient monitoring well network. The original design for the migration control was to intercept, extract/treat, and monitor groundwater downgradient of the disposal areas in both the Front and Back Valleys. As planned, these two systems work independently of each other. Groundwater from the extraction wells is sent through the Front and Back Valley air strippers, where it is then discharged by each system to the Metering Manhole. From the Metering Manhole, effluent goes to the local sewerage district for further treatment (see **Figure 6-2**).

As of December 2001, a total of approximately 47,000,000 gallons of groundwater had been extracted at the site (see **Figure 6-1**). The Front Valley design extraction flow rate is approximately 4 gallons per minute (gpm). The Back Valley design extraction flow rate is approximately 19 gpm. Both flow rates vary due to seasonal groundwater elevation changes **[14].**

6.2.1 Front Valley Extraction System

The Front Valley groundwater extraction system consists of two extraction wells (STW-1 and DTW-1), submersible pumps, and the appropriate piping and electrical/instrumentation controls. Extraction well STW-1 is 55.2 feet deep and screened in the saprolite. The screen is 25 feet in length and the length of the casing is 32.2 feet. The deep extraction well, DTW-1, is 126.5 feet deep. This well consists of 73 feet of casing, a 25 foot screen, 7 feet of blank casing, followed by 20 feet of open borehole in the bedrock. The submersible pump is located within the 7 foot blank casing section.

Six (6) monitoring wells are used to monitor groundwater quality; three of which are in bedrock and three are in the saprolite. There are (12) monitoring wells used to monitor the cone of influence created by the extraction system, seven of which are in the saprolite, the other five are in bedrock. There are (3) piezometers used to monitor the cone of influence created by the extraction system, two are in the saprolite zone the other one is in bedrock. **Table 6-1** lists the Front Valley monitoring wells from which groundwater samples are collected for analyses. **Table 6-2** lists wells and piezometers used to monitor the cone of influence created by the Front Valley extraction system. Refer to **Figure 3-3** for the locations of the wells and piezometers in the Front Valley.

In correspondence dated October 23, 1998, the USEPA directed the PRPs to include monitoring wells IW-1 and BW-6 into the Front Valley monitoring program. Collecting groundwater samples from monitoring well IW-1 is important because currently, the most down-gradient monitoring well being sampled to evaluate groundwater quality, MW-1S, continues to exhibit concentrations of contaminants above ROD performance standards. The last time well IW-1 was sampled was following its installation in 1986. It was deemed clean in the 1987 RI report.

In a November 25, 1998 response, the PRPs agreed to take two initial samples from monitoring well IW -1. The samples were analyzed for VOCs and benzophenone. The PRPs' response highlighted the fact that at this time, it is not warranted to include monitoring well BW-6 as no contamination above the performance standards has been detected in either monitoring wells MW-1BI or MW-1BD. Initially, the USEPA agreed with the PRPs' recommendations. However, depending on the analytical results for the samples collected from monitoring well IW-1, the USEPA may direct the PRPs to incorporate IW-1 and/or BW-6 into the long-term monitoring program for the Front Valley **[3]**. See **Figure 3-3** for the locations of wells SW-4, BW-6, and IW-1.

6.2.2. Back Valley Groundwater Extraction System

The Back Valley groundwater extraction system consists of twelve extraction wells (STW-2, DTW-2, EW-2, EW-3, EW-4, EW-5, EW-6, EW-7, EW-8, EW-9, EW-10, and EW-11), submersible pumps, and the appropriate piping and electrical/instrumentation controls. All extraction wells, with the exception of STW-2, which only extracts water from the saprolite, were designed to extract groundwater from both the saprolite and bedrock zones of the aquifer. For the extraction wells other then STW-2, the pump is located in the blank casing section located below the screened section and above the open bedrock core hole **[3]**.

Currently, 13 monitoring wells are used to monitor groundwater quality in the Back Valley. Six of those wells are in the shallow saprolite zone, three are in the intermediate saprolite zone and four are in the bedrock interface. Refer to **Table 6-3** for the Back Valley monitoring wells.

Fourteen piezometers are used to monitor the cone of influence created by the Back Valley extraction system. Six piezometers are in the shallow saprolite, four are in the deep saprolite zone and four are in bedrock. There are 19 monitoring wells used to monitor the cone of influence created by the Back Valley extraction system. Eleven of those are in the shallow saprolite, four are in the intermediate/deep saprolite zone and four are in bedrock. **Table 6-4** lists wells/piezometers used to monitor the cone of influence of the extraction system in the back valley. Refer to **Figure 3-4** for the location of the wells and piezometers in the Back Valley.

6.3 Groundwater Treatment

The Front Valley Treatment Building houses the groundwater treatment components for the Front Valley. The treatment train includes the following sequence of equipment: equalization tank (FVEQT), packed column air stripper (FVAS), bag filtration, and three carbon filtration units. **Figure 6-2** provides a process flow diagram of the Front Valley treatment system. Treated groundwater is then piped to the Metering Manhole where it is mixed with treated effluent from the Back Valley treatment system. The combined flow is then discharged to the MSD.

The Back Valley Treatment Building houses the groundwater treatment components for the Back Valley. The treatment train includes the following sequence of equipment/ technologies: equalization tank (BVEQT), tray air stripper (BVAS), and pH adjustment.

Originally, the Back Valley air stripper was a "Delta" packed tower air stripper. However, due to the relatively quick iron-scaling on the packing material, this type of air stripper was deemed unsatisfactory for the conditions at the site. With USEPA's approval, the PRPs replaced the "Delta" packed air stripper with a tray air-stripping unit during March/April 1995. The tray air stripper consists of five removable stainless steel trays. Following air stripping, caustic soda is added to the groundwater to raise the pH to the permissible discharge limit (6-10 standard units) as set by MSD. The tray configuration allows the PRPs to remove the iron build-up from the air stripper more expediently, resulting in less downtime for the system.

6.4 Metropolitan Sewerage District (MSD) Permit

The groundwater extraction and treatment system is regulated by the local sewerage district based on a combination of extraction removal efficiency and effluent discharge limits. The Chemtronics site applied and was issued a National Pollutant Discharge Elimination System (NPDES) permit No. NC002491 for the discharge of treated and extracted groundwater to the Metropolitan Sewerage District (MSD) of Buncombe County, North Carolina. **Appendix C** provides a summary (Page 2, Section E, of the correspondence) of the MSD permit history. The permit was first issued on June 20, 1991 and renewed May 1993 with no changes. The December 1993 amended permit reduced the frequency of sampling from quarterly to a semiannually basis and in 1994 the Permit was amended to include modifications to a pretreatment system. Later that same year the contract expired, but was renewed August 26, 1995. The permit was renewed again October 1,1998 increasing the discharge limitations and re-classifying Chemtronics as an insignificant user. There is no documentation as to why the limits were increased. The existing MSD permit has currently expired (as of February 28, 2002), but has been applied for renewal (see **Appendix C**).

6.4.1 Effluent Discharge Limits

The MSD permit regulates three locations: Pipe 01, 02, and Pipe 03. Samples collected from location Pipe 01 are representative of treated effluent from the Front Valley Treatment System. Samples collect from location Pipe 02 are representative of treated effluent from the Back Valley treatment system.

Pipe 03 (or the Metering Manhole) is the treated groundwater from the combination of Pipe 01 and Pipe 02 for the final effluent flow measurements.

According to the permit effective August 26,1995, at Pipe 01, the discharge was limited and monitored for the following chemical parameters: 1,2-dichloroethane, trichloroethylene, methylene chloride, trans-1,2-dichloroethene, benzene, toluene, total trihalomethanes, RDX, picric acid, total cyanide, zinc, benzylic acid, and benzophenone.

At Pipe 02, the chemical parameters monitored according to the August 26,1995 permit were: 1,2-dichloroethane, trichloroethylene, methylene chloride, trans-1,2-dichloroethene, benzene, ethylbenzene, tetrachloroethene, toluene, carbon tetrachloride, total trihalomethanes, RDX, picric acid, total cyanide, lead, chromium, nickel, copper, zinc, and benzylic acid/benzophenone.

Pipe 03 was monitored and limited to the following chemical parameters according to the same permit: 1,2-dichloroethane, trichloroethylene, methylene chloride, trans-1,2-dichloroethene, benzene, ethylbenzene, tetrachloroethene, toluene, carbon tetrachloride, total trihalomethanes, RDX, picric acid, total cyanide, lead, chromium, nickel, copper, zinc, and benzylic acid/benzophenone.

The permit dated October 1, 1998 through February 28, 2002 has the same chemical parameters to be monitored and limited at Pipe 01 and Pipe 03 as the August 26,1995 permit. However, for Pipe 02, the following chemical parameters were no longer required to be monitored: toluene, RDX, picric, and benzylic acid/benzophenone. At no time during this monitoring have the MSD data been reported to the USEPA.

Table 6-5 provides the MSD Effluent Limitations, and analytical results for the five sampling events December 1997, July 2000, December 2000, April 2001 and November 2001 that were provided for this Five Year Review. No other data were available to be reviewed. Compliance with the MSD permit requirements is discussed in **Section 8.3.**

6.4.2 Removal Efficiency

Per the MSD permit, for each treatment unit the removal efficiency in the Front and Back Valley shall be greater than 90%. It is assumed that this applies to all volatile site contaminants, although this is not stated in the permit. This percentage is calculated by using the analysis from the recovery wells before treatment and the effluent analysis from the treatment units before the water is joined again at Pipe 03. The MSD permit is attached as **Appendix C**. As shown in **Figures 6-3, 6-4, and 6-5,** since 1993, the treatment system has met the removal efficiency requirement for 1,2-DCA for the Front Valley and TCE and 1,2-DCA for the Back Valley. It is unclear if the removal efficiency for other volatile compounds has been achieved.

6.5 Institutional Controls

Institutional controls include non-engineering measures such as deed restrictions, water use limitations, fencing, etc., to control or limit potential exposure to receptors when residual contamination remains onsite. The front of the site is fenced with a lockable gate, however, the remainder of the site can be accessed through the woods **[3]**. Fencing was inspected during the site inspection in August 2001 and appeared to be in good condition. No documentation of deed restrictions limiting potential site or groundwater uses was found in the site documents during this Five Year Review.

6.6 System Operation and Maintenance

The latest revision of the Operation and Maintenance (O & M) Manual for the Chemtronics Site Remediation is dated November 1997 **[14].** This manual provides requirements for the groundwater remedial system for the following elements:

Front Valley Remediation System

- Groundwater extraction, treatment and discharge
- Groundwater sampling
- Treatment system sampling
- Caps (DA 10/11, 23)

Back Valley Remediation System

- Groundwater extraction, treatment and discharge
- Groundwater sampling
- Treatment system sampling
- Caps (DA 6, 7/8, Acid Pits)
- Combined metering manhole and automatic sampler
- Automated monitoring and record keeping
- Quality Assurance/Quality Control Requirements
- Permit requirements for discharge to the MSD

The O & M Manual also contains the monitoring reporting requirements, and the statistical procedure for determining compliance for groundwater.

The remediation levels (i.e., performance standards) for the groundwater contaminants of concern are listed in Table 1.1, page 1-3 of the November 1997 Operation and Maintenance Manual **[14]**. All of the wells/ piezometers that are monitored as per the O & M Manual can be found in **Tables 6-1** through **6-4** of this Five Year Review.

Following the review of the June 1995 *Second Year Monitoring Annual Report* **[17]**, the USEPA expressed concern **[18]** to the PRPs about the frequency and duration of malfunctions of both the Front and Back Valley groundwater extraction and treatment systems. The PRPs acknowledged and expressed the same concerns. Consequently, along with preparation of the 1997 *draft Five Year Review Report* **[2]**, the PRPs also prepared a document entitled, "Modifications to the Groundwater Extraction and Treatment System", which was submitted on January 24, 1997 **[19]**.

In reviewing the *draft 1997 Five Year Review Report* **[2]**, the USEPA reiterated the concerns expressed following the review of the June 1995 *Second Year Monitoring Annual Report* **[17]**. USEPA documented these concerns in the April 4, 1997 letter **[18]**. Due to the magnitude and impact of these concerns, the USEPA and the PRPs focused on correcting/improving the deficiencies in these systems instead of finalizing the *draft 1997 Five Year Review report* **[2]**. The primary concerns were:

- the frequency and duration that both groundwater extraction systems were shut down or off-line in each valley

- whether the wells were sufficient to monitor capturing the plume

- high levels of maintenance of the system

Not all of the shut-downs resulted from faulty equipment/design. Numerous shut-downs were caused by adverse weather such as lighting strikes and falling trees, as well as unforseen hydrogeological/geochemical conditions at the site. Nevertheless, due to the numerous shut-downs, USEPA and North Carolina Department of Environment and Natural Resources (NCDENR) deemed that neither groundwater extraction system has operated uninterrupted long enough to establish an accurate picture of the hydraulic control each system is capable of creating.

Another concern highlighted in the USEPA's April 4, 1997 **[18]** letter focused on the potential lack of sufficient monitoring points to adequately measure groundwater levels (i.e., accurately define the limit of the cone of influence created by each groundwater extraction system). However, at that time, it was difficult to determine if sufficient monitoring points *were* present to measure/evaluate the hydraulic control either system exerted on the hydrogeology formations because neither system had operated long enough uninterrupted to achieve maximum extension of the cone of influence around each system. Consequently, it was not possible at that time to confirm the effectiveness of the remedy. One year of uninterrupted operation has occurred and flow rates have stabilized, but no determination could be made as to whether: 1) if the extraction systems were capturing the entire plume in each valley; and 2) if the present monitoring systems were sufficient to adequately monitor the hydraulic influence created by the extraction systems.

Both groundwater extraction/treatment systems have issues associated with the high degree of maintenance required to keep them operable. The following items are the main maintenance obstacles:

- Maintaining an uninterrupted power supply to the site;
- Silt build-up in extraction wells;
- Build-up of iron scale in wells screens;
- Bio-fouling of extraction wells and plumbing;
- Wear on extraction pumps; and
- Failures in electronic control/data acquisition systems.

Due to the numerous shortcomings listed above, USEPA and NCDENR agreed that neither the Front nor the Back Valley groundwater extraction/treatment systems were operational or functional. Thus, the PRPs established the following O&M objectives **[19]**:

- Conduct a thorough evaluation of the Front and Back Valley extraction/treatment systems;

- Attain consistent operation of the Front and Back Valley groundwater extraction and treatment systems;

- Maintain and confirm this level of operation through a systematic O&M approach;

- Modify the existing O&M Manual, where necessary; and

- Maintain disposal area caps by repairing erosional features during regular maintenance activities.

Appendix D summarizes the activities performed to upgrade the extraction/treatment systems in both valleys to achieve the above objectives. The majority of this work was conducted during the summer of 1997. Following the completion of retrofitting of the groundwater extraction/treatment systems in both valleys, representatives from the PRPs, USEPA, and NCDENR met at the site on June 17, 1997 to review the changes implemented at the site.

Operational improvement of the extraction systems occurred immediately after the retrofitting of the systems. However, seven wells (EW-4, EW-5, EW-6, EW-7, EW-8, EW-9, and DTW-2) have had a substantial decline in specific capacity which could be an indication of biological plugging of the wells, after as little as one month of operation **[15]**.

In June of 2000, an audit was performed by the O & M contractor of the groundwater treatment system **[20]**. This audit recommended actions so the system would achieve regulatory compliance; to improve the work environment thus increasing the level of protection for worker health and safety; to improve system performance; and to reduce long-term operating costs. This audit is included as **Appendix E.**

The percentage of time that each well operated increased or was generally the same between January and December 2000. The overall improvement of performance was primarily due to a systematic pump maintenance program that was implemented midway through 2000 **[21]**. During calendar year 2000, actual average extraction flow rates for the Front Valley and Back Valley were 2.14 and 8.47 gpm. This is lower than the design flow rate of 4 and 19 gpm, respectively.

6.7 O & M Costs

Part of this Five Year Review is an evaluation the costs for the remedy. The estimated annual O & M cost was $139,500. The actual annual costs for groundwater treatment are provided *in* **Figure 6-6.** This Figure shows costs at the site have declined per gallon of water treated over time from 7.6 cents per gallon in 1993 to 5.5 cents per gallon in 2000. For 1994-2000, costs averaged $371,357 per year. This is a significant cost increase over the estimated operation and maintenance cost presented in the ROD.

6.8 Monitoring and Reporting Schedule

According to Section 1.3, "Groundwater Sampling Frequency", in the *Sampling and Analysis Plan* of the 1997 O & M Manual for the Chemtronics Site Remediation; groundwater sampling will be conducted quarterly during the first year of remediation, semiannually during years two through five and annually thereafter until remediation is completed **[14]**. This section references Table F.4 of the same document for the schedule of sampling events, however; Table F.4 is not an accurate account of the actual sampling that has occurred. See **Table 6-6** for the actual schedule of the sampling events and reporting activities. As shown in **Table 6-6**, there is a discontinuity in timing concerning the availability of monitoring data via the "Fifth Year Monitoring" reports and the schedule of the Five Year Reviews. For example, the current Five Year Review is due in 2002, but the next Fifth Year Monitoring report is not due until 2003.

6.9 Community Involvement

During the RI/FS, there was considerable community interest in the site. However, with the issuance of the ROD and the implementation of the remedy, community interest in the site has waned. The last Fact Sheet was prepared by the USEPA January 1994. This Fact Sheet provided the public with an update on the status of the site. Since the completion of the remedy, the only inquiries the USEPA has received from the community are from individuals interested in purchasing a home or property near the site. The USEPA was able to assure the potential purchaser the property they were interested in has not been adversely affected, and would not be affected by activities that occurred or are occurring at the Chemtronics site **[3]**.

7.0 Five Year Review Process

The purpose of this Five Year Review is to evaluate the implementation and performance of the remedy to determine if it is protective of human health and the environment. The evaluation of this remedy and the determination of the protectiveness was based on and supported by the data and observations made as part of this review, per the Five Year Review guidance **[1]**.

7.1 Team Members

The following individuals were team members for this Five Year Review process:

- Laura Mahoney, Technical Coordinator, USACE Nashville District
- Becky Terry, Chemist, USACE Nashville District
- Doug Mullendore, Chemical Engineer, USACE Nashville District
- Gregory Mellema, Geotechnical Engineer, USACE HTRW Center of Expertise

7.2 Five Year Review Tasks

7.2.1 Interviews and Site Inspection

A site inspection was performed on August 9, 2001. During this inspection, members of the USACE inspection team met with representatives of Altamont Environmental, Inc, the PRPs O & M contractor and, Norm Sealander, an environmental management consultant for the PRPs. The purpose of the site inspection was to inspect the general condition of process equipment, monitoring wells, extraction wells, piezometers and disposal area caps; fencing, review operation, and maintenance records associated with both extraction systems, and identify information that could be used during this Five Year Review. The Five Year Review checklist is found in **Appendix F.**

During the August 9, 2001 site inspection, the following were observed to evaluate the function of the system and present conditions:

- Disposal area caps and vegetation on landfill cover
- *Surface water drainage*
- Fencing and monitoring wells for signs of vandalism or deterioration requiring repair
- Operation and maintenance records and other applicable site records associated with extraction system
- Settlement monuments
- Treated discharge location
- Process equipment, monitoring wells, extraction wells, piezometers, and air strippers

Monitoring and extraction wells were inspected and found to be secure and well maintained. Although overall O & M activities have improved, the extraction wells maintenance records indicated that the extraction system still requires a substantial amount of maintenance in order for it to operate. The PRPs have addressed this by employing a full-time onsite Operator whose responsibilities include the maintenance of the extraction system. During the inspection, the Operator was questioned regarding the maintenance activities associated with the extraction wells. He discussed how the pumps were removed, cleaned/repaired and placed back into service. The procedure seemed adequate, however, these procedures were not reflected in the current Operations and Maintenance procedures.

Appendix G contains some of the O &M inspection forms now being used. **Appendix H** includes photos taken during the site inspection. The Operator was also questioned regarding the availability of spare parts necessary to keep the extraction system operable. He stated that critical spare parts (mainly controllers), which were not available from a local source, were kept on hand.

The treatment systems for both the Front and Back Valley were inspected. The general condition of both treatment systems was good. During the inspection, corrosion around the base of the Back Valley Air Stripper was observed. Additionally, the Operator stated that he had not determined if the air strippers were level or not. Spare trays for the Back Valley stripper were available, as were spare controller boards for each treatment system. The Operator stated that he monitored the conditions of the pumps and blowers on a daily basis.

Fencing was inspected and appeared to be in good condition. There were no signs of vandalism.

The disposal area caps were inspected and concerns were noted. Problems observed at most disposal areas included "stressed" vegetation and small erosion riffles. Minor signs of erosion on the edge of Disposal Area 10/11 are noted in photo #2 (**Appendix H**), as well as signs of erosion noted in photo # 11 and # 12 at the Acid Pit. Photo # 22 and #23 document the erosion at the Disposal Area and photo # 16 shows the settlement of a small portion of the cap covering the Acid Pit in the northwest corner. Sparse vegetative cover was evident on all caps, but is noted in Photo #15 at the Acid Pit. During the inspection, the O & M contractor stated that the vegetative cover was being reestablished with annual plantings of the appropriate grasses and periodic maintenance. Erosion riffles were being repaired and reseeded as necessary.

Subsidence monuments were observed covered with soil during the site inspection, and according to the current O & M contractor, have not been used to evaluate settlement in the landfill. Subsidence was evident in the Acid Pit Area cap.

The settlement of the caps was evaluated and surveyed in 1996. This survey of the settling markers indicated very little to no settling had occurred in any of the caps at that time. The change in marker elevations ranged from +0.205 inches to -0.205. **Table 7-1** shows the elevations measured following the construction of the caps and the elevations recorded in December 1996 **[3].**

During the inspection of DA-23, a liquid was observed at the base of the disposal area. Refer to photo #24. The location of this seep was immediately south of DA-23 between it and the RCRA unit. However, no seeps were observed emanating from the DA-23 disposal area.

8.0 Technical Assessment

One of the primary purposes of the Five Year Review is to determine the effectiveness and protectiveness of the remedy. Per the *Five Year Review Guidance* **[1]**, the review should address the following three questions:

(A) Is the Remedy Functioning as Intended by the Decision Documents?

(B) Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and RAOs Used at the Time of Remedy Selection Still Valid?

(C) Has Any Other Information Come to Light That Could Call Into Question the Protectiveness of the Remedy?

For the Chemtronics site, the assessment of the remedy and answer to these questions is accomplished by comparing site data and operations to the original remedial action objectives (see Section 5.0) by:

- Evaluation of the trends for the *in situ* groundwater monitoring well data (untreated) by comparing sampling data to the cleanup levels in the ROD (i.e., performance standards/remediation levels)
- Inspection of caps for effectiveness in controlling potential exposure to soils
- Evaluation of the effectiveness of the remedy in capturing the plume, restoring groundwater, and in meeting MSD treatment standards
- Evaluation of the protectiveness of the current performance standards for groundwater and potential updates to ARARs and criteria sine the ROD

8.1 Data Review

The latest *Five Year Monitoring Report* was prepared in July 1998. The next Five Year Monitoring Report is scheduled in 2003.

For this review, data collected during 1998 and 1999 were not summarized in a report or made available. The PRPs agreed to summarize the 2000 and 2001 monitoring data for the purpose of this Five Year Review in order that data more current than 1997 could be used for this evaluation.

Tables 8-1 provide analytical results for 1992, 1993, 1994, 1995, 1996, 1997, 2000, and 2001 for the following volatile organic compounds (VOCs) for the wells/piezometers listed on **Tables 6-1 through 6-4** according to the O & M plan: 1,2-dichloroethane, 1,2-dichloroethene, benzene, bromoform, carbon tetrachloride, chloroform, ethylbenzene, methylene chloride, tetrachloroethene, toluene, and trichloroethene (see **Figures 3-3 and 3-4** for locations of the monitoring wells). **Table 8-5** provides a summary of the qualifiers used for validation of the analytical data.

In addition to the wells/piezometers listed in the O & M plan on **Tables 6-1 through 6-4**, the following locations were sampled and analyzed and the data are presented in **Table 8-1** for the volatile organic compounds listed above: Front Valley/Carbon #1 Effluent (FVCAR-1), Front Valley/Carbon #3 Effluent (FVCAR-3), Back Valley Air Stripper (BVAS), Front Valley Air Stripper (FVAS), Back Valley/Equalization (BVEQT), Front Valley Equalization (FVEQT), Front Valley/EPA Spike (MW-10 and MW-11), and the "Metering Manhole".

8.1.1 Organics

It should be noted that the method reporting limit was greater than the Performance Standard (PS) for all of the organic constituents on at least one occasion during the sampling events. For example, the PS for 1,2- dichloroethane (DCA) was set at 5 parts per billion (ppb or ug/l); which was exceeded by the method reporting limit on one or more occasion for the following wells: SW-2, MW-1BD, MW-1B1, SW-4, MW-2B, MW-4B, MW-2D, MW-3D, MW-3S, SW-12, and SW-13 (see **Table 8-1**).

For organic data review, it appears that for the last two sampling events; December 14, 2000 and November 1, 2001, the method reporting limit did *not* exceed the PSs at any well or any constituents with the exception of BW-4. At BW-4 all organic constituents exceeded the method reporting limit with the exception of 1,2 DCA.

At well M85L9, (a back valley saprolite well), it appears from **Figure 8-1A** that a slight downward trend is occurring for 1,2-dichloroethane, chloroform, and trichloroethene. However, by examining **Table 8-1,** it can be noted that concentrations for all three compounds are well above the PSs for all events. Also, at well M85L9 concentrations for methylene chloride, and tetrachloroethene, were detected at or above the PS for all events (see **Figure 8-1B).** The concentrations for benzene was detected below the PS for the 2000 sampling event and detected above the PS for the 2001 sampling event (see **Table 8-1).**

A decreasing trend is occurring in trichloroethene at well MW-4B; however, it is still above the PS (see **Figure 8-2 and Table 8-1).**

In well IW-2 DCA has decreased in concentration from 25,000 ppb in 1992 to 260 ppb in the 2001 sampling event (see Figure **8-3A and 8-3B)**. The PS is 5 ug/l for DCA. For the last two sampling events at IW-2, the concentrations for methylene chloride, and 1,2-dichloroethene are less than the PS. However, the results for benzene and trichloroethene for the 2000 and 2001 sampling event are still above the PS.

At BW-9, concentrations for DCA have also decreased from the initial sampling in 1992 from 13,000 ppb to 5,900 ppb and 3,600 ppb for the 2000 and 2001 sampling events, respectively. However, these concentrations are still 1000 times the PS for this constituent. There is also a decreasing trend in the benzene concentrations from 3,100 ppb detected during the initial sampling event in 1992 to 1,500 ppb and 1,100 ppb in the 2000 and 2001 sampling event. Concentrations for benzene are also still above the PS (see **Figure 8-4A and Table 8-1).** Chloroform, methylene chloride, and TCE concentrations at BW-9 are also above the PS for the last two sampling events and 1,2-dichloroethene was above the PS for the 2000 sampling event (see **Table 8-1 and Figure 8-4B).**

The PS was exceeded on one or more occasion at MW-5S during the 2000 or 2001 sampling events for the following constituents: DCA, benzene, bromoform, trichlorethene, methylene chloride, carbon tetrachloride, and carbon tetrachloride. Concentrations for ethylbenzene, tetrachloroethene, 1,2-dichloroethene, and toluene were below the PS for both events at this well (see **Table 8-1** for concentrations).

MW-3B is also above the PS for the 2000 and or the 2001 sampling event for all organic constituents with the exception of toluene, tetrachloroethene, ethylbenzene, chloroform, bromoform, and carbon tetrachloride.

At BW-4, all organic constituents were above the PS for the 2000 sampling event. For the 2001 sampling event, all organic constituents were below the PS with the exception of DCA (see **Table 8-1** for concentrations).

The following wells have *not* had an exceedence of any organic constituent for the past two years: MW-1BD, MW-1B1, MW-3D, SW-8, SW- 13, SW-12, MW-3S, and SW-2.

MW-1S, MW-2B, MW-4B, MW-2D, were below the PS for the past two sampling events for all constituents with the exception of 1, 2-dichloroethane at MW-1S, and trichloroethene at MW-2B, 2D, and MW-4B.

SW-4 only had data for the 1992 and 1994 sampling events. For both sampling events, either the method reporting limit exceeded the PS, or the concentration was above the PS for the following constituents: 1,2-dichloroethane, benzene, carbon tetrachloride, tetrachloride, and trichloroethene.

Figures 8-6 through 8-7 show the organic constituents that exceeded the PS for the sampling event in October 2001 for the Back and Front Valley.

8.1.2 Inorganics

The inorganic parameters analyzed on groundwater at the Chemtronics site per the O & M plan are the following: chromium, copper, cyanide, lead, nickel, and zinc. Inorganic results can be found in **Table 8-2** for 1992-1997 and 2000- 2001. The following is a summary of the metals detected at or above the Performance Standards (PS) at each individual well (see **Figure 8-8 and Figure 8-9)**:

- BW-9, four detections of chromium, twelve out of fifteen for nickel, and two detections for lead at or above the above the PS
- MW-3B, one detection of lead above the PS
- MW-4B, five detections of chromium above the PS
- IW-2, one detection of nickel above the PS and two detections of lead at or above the PS
- MW-2D, four detection of chromium above the PS
- M85L9, one detection of chromium and six detections of lead above the PS
- MW-3S, two detections of chromium above the PS

- BW-4, MW-1BD, MW-1B1, MW-2, one detection of chromium above the PS
- MW-5S, nine detections of chromium and one of lead above the PS
- SW-12, two detections of chromium and three of lead above the PS
- SW-13, Two detection of chromium and one detection of lead above the PS
- SW-8, three detections of chromium above the PS
- MW-10 (EPA Quality Control Sample), one detection of chromium and lead above the PS
- MW-1S, four detections of chromium above the PS
- SW-2, two detections of chromium, and two detections of lead above the PS
- MW-12, MW-3D, and SW-4 --no inorganics detected above the PS at any sampling event.

In addition to the wells discussed above, results for the following locations can be found in **Table 8-2**:

- Metering Manhole
- BVAS
- FVCA1I
- FVCAR-1
- FVCAR-3 and FVCA3E

8.1.3 Benzophenone

Table 8-3 provides the analytical results for the years 1992-1997 and 2000-2001, for the O & M monitoring wells listed on **Table 6-1** for benzophenone. Benzophenone is a contaminant of concern (COC), with an established ROD PS of 152 ug/l. The only wells in which benzophenone were reported above the PS were: MW-1S, and SW-4. At all the remaining locations the concentrations were reported less than the PS for all years.

In addition to the wells listed on **Table 6-1**, results for the following locations can be found in **Table 8-3**.

- Metering Manhole
- FVAS and FVCA-1I
- FVCAR-1 and FVCA-1E
- FVCAR-2
- FVCAR-3 and FVCA-3E
- FVEQT

8.1.4 Explosives

A summary of the explosives data is provided on **Table 8-4**. Explosives identified to be analyzed on the O & M plan were the following: 2,4,6-trinitrotoluene (TNT), benzylic acid, picric acid, and RDX.

Concentrations for TNT were reported less than the method reporting limit or at concentrations less than the PS for all sampling events and at all sampling locations.

All concentrations for picric acid were also reported less than the method reporting limit or less than the PS at all locations and all sampling events.

Benzylic acid was not reported for any well during the November 1, 2001 sampling event.

AT BW-4, benzylic acid exceeded the PS or the method reporting limit was above the PS for five of sixteen sampling events. RDX was reported less than the PS for all sampling events at BW-4.

At MW-1BD, benzylic acid exceeded the PS or the method reporting limit was above the PS for five of the sixteen sampling events. RDX was reported less than the PS for all sampling events at MW-1BD.

At MW-1B1, benzylic acid exceeded the PS or the method reporting limit was above the PS for five of the sixteen sampling events. RDX was reported less than the PS for all sampling events at MW-1B1.

AT MW-1S, benzylic acid exceeded the PS or the method reporting limit was above the PS for six of the sixteen sampling events. RDX was reported above the PS only twice at MW-1S.

SW-4 has results for only one sampling event. For the 1992 event, benzylic acid was reported greater than the PS and RDX was reported below the PS.

At SW-2, benzylic acid exceeded the PS or the method reporting limit was above the PS for five of sixteen sampling events. RDX was reported less than the PS for all sampling events at SW-2.

In addition to the wells listed on **Table 6-1**, results for the following locations can be found in **Table 8-4**.

- Metering Manhole
- FVAS and FVCA-1I
- FVCAR-1 and FVCA-1E
- FVCAR-2
- FVCAR-3 and FVCA-3E
- FVEQT

8.1.5 Biodegradation of Chlorinated Solvents

Use of chlorinated solvents during site activities at Chemtronics has caused groundwater contamination. However, a number of processes such as biodegradation can occur over time and in favorable conditions. During biodegradation, contaminants may degrade to other products that may or may not be more harmful than the original contaminants. **Figure 8-5** shows the natural path for biodegradation for chlorinated solvents beginning with tetrachlorethene (PCE) going to trichloroethene, 1,2-DCE and vinyl chloride, finally to ethane. For this site, the current O &M analytical protocol does not include some of the intermediate products such as vinyl chloride, ethene or ethane. For future analysis, it may be advisable to include at least vinyl chloride (which is a known human carcinogen) in future O & M monitoring analysis.

8.2 Evaluation of Groundwater Capture

As noted in Section 5.0, the RAOs relevant to groundwater at the site are as follows:

- To prevent offsite migration of groundwater contamination; and
- To restore contaminated groundwater to levels protective of human health and the environment.

As discussed above in **Section 6.2.1 and 6.2.2,** the groundwater extraction/treatment systems have had a history of operational problems. From 1993 through 1996, both the Front Valley and Back Valley groundwater extraction/treatment systems operated sporadically. The changes/modifications implemented in 1997 (see **Appendix D**) have increased the efficiency and reliability of these systems.

Figures 8-6 through **8-7** show contaminant plumes for organics from the most recent sampling data available (October 2001) for the Front and Back Valleys, respectively. **Figures 8-10 and 8-11** show the plume maps as of 1997. Even with the many O & M improvements, the monitoring well network for both valleys is insufficient to make an accurate determination as to whether the extraction system is effectively capturing or containing site groundwater. No information is available to determine if the plume size is stable, is being reduced as a result of pumping and treating the groundwater, or is growing. Based on an analysis of the drawdown, it appears that the plume is being captured but this analysis is not supported by the analytical data collected from locations downgradient of the extraction system. This determination is critical to determine whether the remedy is functioning as intended by the ROD.

Another RAO and measure of the remedy is whether concentrations of site contaminants in groundwater levels are decreasing to levels that are protective of human health and the environment, i.e., are meeting the groundwater performance levels given in the ROD, and give evidence of being "restored" (see **Tables 8-1 through 8-4** and Section 8.1, above). This evaluation should be further supported by the statistical procedure to compare monitoring levels to "baseline", as described in the O &M manual **[14]**. It is assumed that this evaluation will be performed in the forthcoming *Fifth Year Monitoring Report*, due in 2003.

In general, although some contaminant levels in some wells have indicated a decrease, many groundwater concentrations *in situ* (prior to treatment) are still not meeting the groundwater performance standards set forth in the ROD. Furthermore, most of the current groundwater ARARs are lower than the existing ROD levels (see **Section 8.5** below). Thus, onsite groundwater would not *currently* be considered to be "restored", or protective of human health, per the RAOs, although they may be in the future.

The determination as to whether the treatment system is *on schedule* to remediate the groundwater could not be evaluated because no schedule endpoints for such a determination were provided.

Per the RCRA guidance, the *Environmental Indicators*, "current human exposure under control" and " migration of contaminated groundwater is under control" **[22]**, are not demonstrated due to the insufficient monitoring well network.

8.3 Metropolitan Sewerage District Compliance

Table 6-5 referenced above provides the MSD Effluent Limitations, and analytical results for the five sampling events December 1997, July 2000, December 2000, April 2001 and November 2001 that were provided for this Five Year Review. No other data were available to be reviewed.

The MSD permit and limits were discussed in Section 6.4.1. To date, the treatment system has operated with minimal violations.

For the Front Valley, Pipe 01, all values reported were below the discharge limitations, with the exception of picric acid and benzylic acid/benzophenone that were not reported for the December 2000 sampling event. Also, there was no data for the July 2000 discharge for benzylic acid/benzophenone, because a lab was not identified to run the analysis.

For the Back Valley; Pipe 02, nickel exceeded the MSD Effluent Limitations for the discharges for the December 1997, July 2000, December 2000, and April 2001. The effluent discharged November 2001 would also have exceeded the limitations if the MSD personnel had not agreed to increase the limitation from 0.28 mg/l to 0.70 mg/l after a May 7, 2001 meeting **[23]**. The discharge limitation was also exceeded for lead during the December 1997 discharge.

At the Metering Manhole, RDX exceeded the MSD effluent limitations for the December 1997 discharge. The discharge limitations for nickel were exceeded for all dates with the exception of the November 2001 discharge. After the meeting on May 7, 2001, the discharge limitation for the metering manhole was increased from 0.042 lbs/day to 0.121 lbs/day for nickel **[23].**

On April 10, 2001 a Notice of Violation (NOV) was issued by the Buncombe County MSD **[16]** to the Chemtronics site groundwater remediation project. The NOV identified three items:

- Benzylic acid and benzophenone were to be analyzed as one test, and picric acid as a separate test. This was not done for the analysis of the December 2000 discharge water.

- Nickel exceeded the allowable limit in the samples collected from the Back Valley discharge and the Metering Manhole in December 2000.

- The concentration of benzylic acid and/or picric acid exceeded allowable limits in the sample collected from the Metering Manhole in December 2000.

These items were addressed by re-sampling the discharge water, analyzing the new samples required by the permit, and meeting with MSD personnel to discuss the analytical results. Samples were collected and analyzed on April 20, 2001. Results from the resampling indicated nickel exceeded the allowable discharge limitations for the Pipe 02 (Back Valley) and Pipe 03 (Metering Manhole). No other permit levels were exceeded. Based on the May 7, 2001 meeting, MSD agreed to increasing the allowable concentration of nickel in Pipe 02 from the current limit of 0.280 mg/L to 0.70 mg/L. Additionally, MSD modified the allowable amount of nickel at Pipe 03 from 0.042 lbs/day to 0.121 lbs/day. Based on the new MSD discharge limits, neither the concentration at Pipe 02 or 03 was in exceedence **[23].**

Per the MSD permit, the removal efficiency for each treatment unit in the Front and Back Valley shall be greater than 90%. As shown in **Figures 6-3 through 6-5,** since 1993, the treatment system has met the removal efficiency requirement for 1,2-DCA for the Front Valley and TCE and 1,2-DCA for the Back Valley. The removal efficiency for other constituents in the Front and Back Valleys could not be determined.

Even though the treatment system is currently functioning relatively well, as noted above, and the treated groundwater is meeting most of the MSD limits, the MSD levels are not risk-based, and the fact that treatment is necessary precludes unrestricted or residential use at this time. In addition, the MSD data are not specifically required by the ROD, and are currently not being reported to the USEPA.

8.4 ARARs Update

One of the purposes of the Five Year Review is to review federal and state requirements promulgated or modified *after* the ROD to determine if changes are necessary to ensure protection of human health and the environment. Newly promulgated or modified State requirements evaluated included:

- SDWA Maximum Contaminant Levels (40 CFR 141)
- North Carolina Groundwater Standards and Classifications (NCAC T15A: 02L.0200), promulgated on November 23, 1993
- North Carolina Water Quality Standards (NCAC T15A: 2B), promulgated on March 3, 1993
- North Carolina Inactive Sites Program, Guidelines for Assessment and Cleanup
- North Carolina Air Quality Standards (NCAC T15A: 2D, promulgated on April 1, 1995 and North Carolina Air Quality Permit Requirements (NCAC T15A: 2Q), promulgated on August 1, 1995 **[3]**.

Groundwater/Drinking Water

Table 5-1 listed the groundwater performance standards from the 1988 ROD as well as the current federal MCLs and the current North Carolina groundwater quality standards. Several new federal MCLs have been promulgated since the 1988 ROD, the most significant departure from the ROD levels being the MCL for methylene chloride (from 60 to 5 ug/L). Although the lifetime Health Advisories listed for the explosives RDX and TNT are not MCLs, they are comparable to approximate a lifetime exposure.

In comparing the ROD groundwater performance standards to current standards, all site constituents have new ARARs except for picric acid, benzophenone and benzylic acid. **Table 5-1** is shaded in all incidents where the new ARAR is lower than the original performance standard. As shown in **Table 5-1**, all of the new groundwater ARARs are *lower* than the ROD levels except for trans-1,2-dichloroetheylene and chromium. In all cases where the State of North Carolina has established a groundwater standard for a chemical, the State's groundwater criterion is either equal or set at a lower concentration then the MCL. However, there was a question in the draft 1997 Five Year Review as to the need to revise the performance standards for the Chemtronics site based on lower ARARs since the levels of contamination in the groundwater continue to exceed the higher performance standards set in the 1988 ROD **[3]**.

Soil

Although the North Carolina *Inactive Sites Program, Guidelines for Assessment and Cleanup* have been produced since the ROD was signed, these were considered to affect the evaluation of the remedy since potential soil exposure was addressed by the site cap, which is intact.

Air

Although new air quality standards have been promulgated in North Carolina since the ROD was issued, these are not considered further because in a letter dated March 19, 2001 to the O & M contractor (see **Appendix I**), the Western North Carolina Regional Air Quality Agency (WNCRAQA) has determined that the air strippers no longer required a permit. In their letter, the agency noted that a permit is not required for CERCLA activities carried out entirely onsite, and the air permit No. 11-GRW-335 for Volatile Organic Compounds (VOCs) and Toxic Air Pollutants dated February 8, 1999 would be allowed to expire on March 31, 2001. However, the letter also said that this did not relieve the facility of compliance with any *substantive requirements* listed in the WNCRAQA Air Quality Code.

Surface Water

Although new surface water quality standards have been promulgated in North Carolina since the ROD was issued, these are not considered further because the ROD did not specifically address surface water and sediment remediation. These ARARs may be applicable if it is determined that the surface water/sediment pathway needs to be evaluated in future site actions.

8.5 Assessment Summary

With the exception of the small erosion channels caused by stressed vegetation and one area of subsidence, the caps on the disposal areas appear to satisfy the RAOs for soil exposure for this site.

Repairs and upgrades to the groundwater extraction and treatment system have improved overall system reliability. With the exception of extraction well EW-5, it appears that past operation and maintenance issues have been addressed to an extent that has significantly reduced the variability in the average gallons of water pumped from each well per month. **Figure 6-1** presents monthly and cumulative pumping volumes. It is evident that since 1997, the treatment system has been under better operational control.

Although generally speaking, a non-statistical, decreasing trend for some site contaminant levels can be observed, the groundwater performance standards are still not being met for many of the monitoring wells.

Also, as mentioned in the Data Analysis Section (Section 8.1 above), the method reporting limit was greater than the groundwater performance standards for several analytical parameters and on numerous occasions. On these occasions, it is impossible to determine if the PS were being met. It was also not possible to determine if the analytical methods were in control, since no quality data was submitted for review. Also, according to the O & M contractor's contract laboratory, no specific analytical procedure of benzylic acid is available. Thus, on several occasions, benzylic acid has not been analyzed.

Many of the ARARs have changed since the ROD was prepared. Most significant are the North Carolina groundwater standards that are much lower than the ROD performance standards. Because the NC levels are much lower, the protectiveness of the existing ROD groundwater performance standards are in question of being sufficiently protective of human health. Even though the treatment system is functioning relatively well, as noted above, and treated groundwater is meeting most of the MSD limits (see Section 8.3), these levels are not risk-based, and the fact that treatment is necessary precludes unrestricted or residential use at this time. In addition, the MSD data are not specifically required by the ROD, and are currently not being reported to the USEPA.

Because the risk assessment was not available, it was not possible to evaluate whether changes in exposure pathways, toxicity and other contaminant characteristics have occurred since the ROD was issued. However, it is highly likely that some toxicity factors *have* changed since the time of the RI. It is doubtful that the original exposure scenarios have changed to any degree, except that there are no current site workers except the O & M contractor. Also, the state-of-the art of risk assessment have changed substantially since the risk assessment was prepared, including the USEPA's guidance and methods, default exposure parameters, and methods for assessing the air and dermal pathways. In addition, there was evidently no ecological risk assessment performed for the site, which is a required component of all CERCLA risk assessments performed currently.

If a risk assessment were re-done for the site, it would surely be a significantly different evaluation than that performed for the RI. However, it would likely result in the same human exposure pathway being of primary concern, i.e., the potential ingestion of groundwater by future residents. Because there is likely a continued discharge to surface water and sediment, this is likely an additional pathway of concern, especially for potential ecological receptors.

The principal assumptions and conditions during the ROD which identified *ex situ* treatment of groundwater as the most appropriate method for remediating the groundwater at the site should be revisited. Since the ROD was signed, many *in situ* treatment technologies have been developed that might be useful in either reducing the amount of water that needs to be extracted, or in eliminating extraction of groundwater from the treatment scheme.

9.0 Issues

The following issues were observed during the August 2001 site inspection and subsequent review of site data:

Table 9-1. List of Significant Issues		
Issues	**Affects Protectiveness? (Y/N)**	
	Current	**Future**
1. No Data Quality Objectives (DQOs) for the site, including intermediate and long-term remedial goals, and the required time frames necessary to evaluate the effectiveness of the treatment system, were identified in any site documents [22].	N	Y
2. Corrosion was observed around the base of the Back Valley Air Stripper.	N	N
3. O&M procedures developed over the last several years were not included in the O&M Manual.	N	N
4. The monitoring well network was insufficient to make the determinations required as part of this Five Year Review.	N	Y
5. Stressed vegetation and minor erosion were observed on many caps.	N	Y
6. Extraction wells still require frequent and intense maintenance.	N	N
7. Standing liquid was evident at the base of DA-23.	N	Y
8. Air stripping influent water was not monitored for the required water quality parameters (hardness, calcium, Fe+2, TSS, pH, Mn, total solids, and alkalinity)	N	N
9. Settlement of disposal area caps has not been measured or recorded since 1996.	N	N
10. No evaluation of the draw down and capture zone efficiency has been performed.	N	Y
11. Detection limits for many constituents are not sufficient to monitor for the current groundwater performance standards.	N	Y
12. There have been violations of the MSD permit limits.	N	Y
13. The MSD permit has expired and has not been updated.	N	Y

Table 9-1. List of Significant Issues		
Issues	Affects Protectiveness? (Y/N)	
	Current	Future
14. There is no documentation of the institutional controls at the site.	N	Y
15. MSD data is not reported to the USEPA.	N	N
16. Analysis of all relevant breakdown products is not being performed in the O & M monitoring (e.g., vinyl chloride).	N	Y
17. Data from 1998 and 1999 were not available for this review.	N	N
18. New groundwater standards have been promulgated in NC, and there are lower federal MCLs.	N	Y
19. Many of the groundwater performance standards are not being met in many of the wells.	N	Y
20. No ecological risk assessment has evidently been performed.	N	Y
21. The human health risk assessment is likely outdated in regard to toxicity factors, default exposure parameters and methodologies, but is not expected to affect the outcome, as groundwater standards were ARAR-based.	N	Y
22. There are potentially other site contaminants and additional groundwater plumes associated with the RCRA units.	N	Y
23. The current reporting schedule is insufficient.	N	N
24. Settlement of Acid Pit Cap is evident.	N	Y

In summary, the answers to the three questions in this Five Year Review are as follows:

(A) Is the Remedy Functioning as Intended by the Decision Documents? --- ***NO***

(B) Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and RAOs Used at the Time of Remedy Selection Still Valid? --- ***NO***

(C) Has Any Other Information Come to Light That Could Call Into Question the Protectiveness of the Remedy? ***--YES***

10.0 Recommendations and Follow-up Actions

The following recommendations are offered as a result of this Five Year Review.

Table 10-1. Summary of Recommendations and Follow-Up Actions

Recommendations			**Follow-up Actions: Affects Protectiveness? (Y/N)**	
	Responsible Party/Agency	**Milestone Date**	**Current**	**Future**
I. Prepare a Holistic Site Management Plan (HMP) At a minimum, this plan should: • Define interim performance criteria that will be used to evaluate the effectiveness of the treatment system at obtaining remedial action objectives. • Develop a contingency remedy such as in-situ chemical oxidation, enhanced in-situ biological reduction, and permeable reactive wall for the achievement of the groundwater RAO's; • The HMP should develop specific requirements for the assessment of system performance and should establish a structure and schedule for reporting requirements for the annual and monthly monitoring report, MSD data, and significant correspondence regarding the discharge limitations. An Annual	PRPs/USEPA	January 2003	N	Y

Performance Evaluation should be should prepared that describes the effectiveness at meeting the remedial performances objectives. • Revise the long-term O & M compliance monitoring program with consideration of items such as the hydraulic controls, groundwater monitoring well frequency, well network, analytical suite, sample collection, analytical procedures, surface water monitoring requirements, maintenance of landfill caps, and to include wells near the perimeter of the plume in both valleys. • Establish a process for coordinating future CERCLA monitoring and remedial actions with on-site RCRA activities. • Describe current and anticipated future site use, including existing or proposed institutional controls or deed restrictions. • Establish a process and schedule for periodically updating the O & M manual. • Revise the O & M Manual so that activities are not dependent on the operating contractor, and develop a schedule and process for monitoring 1) settlement of landfill caps, 2) erosion, 3) over seeding and vegetative covers, and 4) general maintenance.				
II. Reevaluate the current groundwater cleanup levels in light of current ARARs	PRPs/USEPA	2002	N	N
III. Reevaluate or more clearly define the "trigger mechanism" in the ROD	PRPs	2003	N	N
IV. Evaluate the need to perform an ecological risk assessment, including	USEPA	2003	Y	Y

the evaluation form the potential presence of endangered or threatened species.				
V. Review and approve the Holistic Site Management Plan.	USEPA	2003	Y	Y

11.0 Protectiveness Statements and Next Review

The portion of the site remedy dealing with potential soil exposures (i.e., the caps) appears to be protective of human health and the environment.

Since there are no current onsite groundwater receptors and there is currently no indication of contaminated groundwater or surface water exiting the property, the remedy is considered protective in the short-term. Groundwater at the Chemtronics site is not protective of human health and the environment in the long term due to the following reasons: the current monitoring well system is insufficient to determine if the plumes are being captured, groundwater is likely migrating to a degree and discharging to adjacent surface water, groundwater performance standards are not being met onsite and groundwater is not currently "restored", as ARARs are lower than the ROD standards, MSD violations have occurred, and there is no documentation of deed restrictions or future groundwater use restrictions for the site.

The next Five Year Review should be scheduled five years from the date of this Review, in April 2007.

12.0 References

[1] United States Environmental Protection Agency (USEPA), 2002. Comprehensive Five-Year Review Guidance, EPA 540-R-01-007, June 2001.

[2] RUST Environmental And Infrastructure Inc., 1997. Draft Five Year Review Report for Chemtronics Site Remediation Swannanoa, NC to United States Environmental Protection Agency – Region 4, February 1997.

[3] United States Environmental Protection Agency (USEPA), 1999. Draft Five Year Review Chemtronics Superfund Site, Swannanoa, Buncombe County, North Carolina, June 1999.

[4] United States Environmental Protection Agency (USEPA), 1988. Enforcement Record of Decision Remedial Alternative Selection, Chemtronics Superfund Site, Swannanoa, Buncombe County, North Carolina, April 5,1988.

[5] United States Environmental Protection Agency (USEPA), 1989. Amendment to the Enforcement Record of Decision Remedial Alternative Selection, Chemtronics Site, Swannanoa, Buncombe County, North Carolina, April 26,1989.

[6] Sirrine Environmental Consultants, 1991. Final Design Analysis, Chemtronics Site Remediation, Swannanoa, North Carolina, February 1991.

[7] Altamont Environmental, Inc., 2002. Meeting slides from Chemtronics meeting with Principal Responsible Parties, Altamont, USACE, and EPA, January 23, 2002.

[8] Altamont Environmental, Inc., 2002. Transmittal letter from Stuart A. Ryman, Project Coordinator, to Laura Mahoney, USACE, March 5, 2002.

[9] United States Environmental Protection Agency (USEPA), 1985. Administrative Order on Consent In the Matter of Chemtronics Site, October 1985.

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